

Rendez-vous of dwarfs

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Abstract. We present observations of multiple system of dwarf galaxies at the Russian 6-m telescope and the GMRT (Giant Metrewave Radio Telescope). The optical observations are a part of the programme Study of Groups of Dwarf Galaxies in the Local Supercluster. The group of galaxies under consideration looks like filament of 5 dwarfs. Two faint galaxies show peculiar structure. Long slit spectrum reveals inner motions about 150 km/s in one of them. It suggests that the galaxy is on stage of ongoing interaction. Probably, we see the group in moment of its formation.

1 The main parameters of the group

During the work on the catalog of groups of galaxies Makarov et al. (2010) [1] have been found interesting groups of dwarf galaxies. One of these groups we have studied in detail at the 6-m telescope and GMRT.

The SDSS image of the group is presented in Fig. 1. The parameters of individual galaxies are indicated in Table 1. The columns contain the following data: the number in the group, the name of the galaxy (for SDSS galaxies the coordinates in the name are omitted), the coordinates at the epoch J2000.0, mean radial velocity of the group relative to the centroid of the group, total magnitude in the SDSS *g*-band, absolute *g*-band magnitude, and luminosity in units of $10^8 L_\odot$.

The projection distance between the outermost galaxies, determining the size of the group amounts to 190 kpc. The mean velocity of the group, weighted over the velocity errors, amounts to 2675 km/s. Total luminosity of all galaxies in the SDSS *g*-band is approximately $1.6 \cdot 10^9 L_\odot$. The velocity dispersion for this group is approximately 20 km/s. Total mass, calculated via the projected mass estimator method, is equal to $1.5 \cdot 10^{11} M_\odot$ and the M/L ratio is about 110 in solar units in *g*-band.

The groups of our sample have small dispersions of velocity and projected distances between galaxies. It makes

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Table 1. List of galaxies.

No.	RaDec(J2000)	V_{LG} , km/s	<i>g</i> , mag	M_{abs} , mag	L_g , $10^8 L_\odot$
1	124412.1+621019	2682	17.78	-15.15	1.28
2	124418.0+621007	2650	18.08	-14.82	0.95
3	124423.2+620306	2660	17.53	-15.38	1.58
4	124412.0+621451	2614	15.82	-17.05	7.38
5	124359.9+621960	2602	16.16	-16.70	5.35

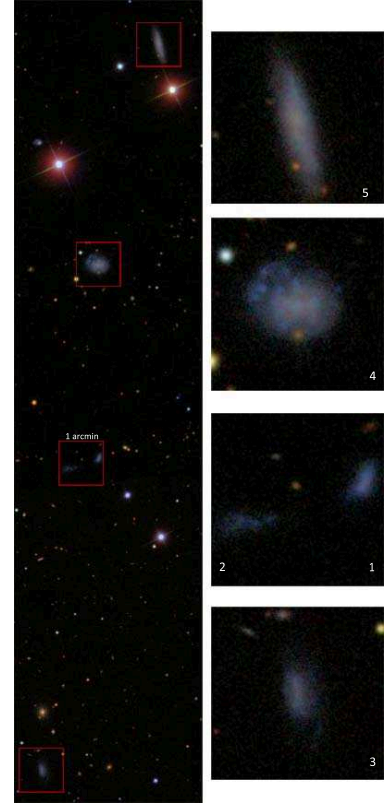


Fig. 1. A SDSS DR7 image of the studied galaxy group. Left: the image of the entire group. The red squares mark the regions with angular sizes of 1 arcmin. Right: the same regions magnified with $\times 4$. The number of the galaxy in the group is indicated in the plots.

them look like the associations of dwarf galaxies from Tully et al. (2006) [2].

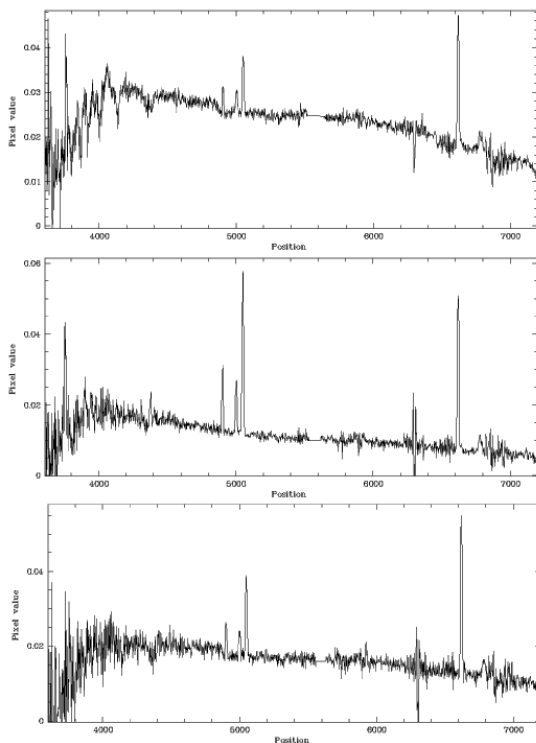


Fig. 2. BTA/SCORPIO spectra for the 1st and 2nd galaxies at the wavelength range of 3600–7200 Å. The upper plot represents the spectrum of the first galaxy, the middle and bottom plots — the second galaxy. The spectra of the second galaxy have a velocity difference of about 150 km/s, what indicates the interaction effects in this galaxy.

2 Observations

2.1 BTA

We observed 1st and 2nd galaxies on the 6-m BTA telescope on August, 2009 with the SCORPIO focal reducer [3]. We used the VPHG550G grism and a long slit with the size of $1'' \times 360''$. The wavelength range of the grism is 3100 – 7300 Å. The long slit was simultaneously centered on the brightest regions of both galaxies. After the standard processing of two-dimensional spectra in the ESO-MIDAS package we extracted 3 one-dimensional spectra. The spectra are shown in Fig. 2. In general the spectra are emission dominated but the spectrum of 1st galaxy has appreciable absorptions in the hydrogen lines. Apart from emissions in the hydrogen lines, the spectra contain the emission lines of [OIII], [SII] and others. We determined the metallicity (oxygen abundance) with a reasonable accuracy for only one spectrum (Fig. 2, middle panel). The value of $12+\log(\text{O}/\text{H})$ is 7.2 ± 0.1 . To find the metallicity we use a direct method based on [OIII] $\lambda 4363/(\lambda 4959 + \lambda 5007)$ ratio [4].

Hence, it is a rather low-metallicity galaxy (a little higher metallicity than that of I Zw 18). Spectrum of 1st galaxy shows sign of low metallicity too. An important feature of the 2nd galaxy is a difference between the radial velocities of parts of this galaxy. It amounts to 150 km/s.

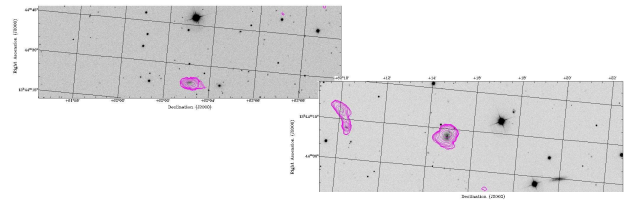


Fig. 3. GMRT HI map of the group with resolution 10kλ. The beam of the HI map is 10kλ: 25.11 x 22.18 arcsec, PA = −11.30°.

Table 2. Total HI masses.

Galaxy	Velocity spread, km/s	HI mass, $10^8 M_\odot$
1, 2	2460-2543	2.15
3	2361-2523	4.81
4	2369-2488	3.74

2.2 GMRT

Fig. 3 present GMRT data obtained on April 2010.

Three clouds of HI were observed in the field, one covering galaxies numbered 1 and 2, one covering galaxy no 3, and another covering galaxy no 4. Basic parameters for these three clouds presented in Table 2.

3 Conclusions

The mass-to-luminosity ratio for the group is more than $100 M_\odot/L_\odot$. It indicates the presence of significant amount of the dark matter.

The objects 1 and 2 are on stage of merging of two dwarf galaxies. It is indicated by structure of distribution of HI cloud and high difference in the velocity in the clumps in the galaxy.

The dwarfs in the group form the chain of the galaxies. We see the group in the process of the formation. Low metallicity of the gas in the galaxies support idea of "youth" of the galaxies. In addition we have found another candidate for very low-metallicity galaxy. The chain shape of galaxies indicates that the group had not yet virialized. Thus we see young emerging group of dwarf galaxies.

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References

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